International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM 2018 vol.18 N1.4, pages 951-958

Ultra dispersed magnetite as a catalyst for aquathermolysis of heavy oil

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© SGEM2018. Presently intensification of heavy oil production, particularly by applying various catalytic systems, is very attractive and relevant task for many researchers. Catalysts intensify a destruction process of high molecular compounds such as resins and asphaltenes. Thus, providing irreversible viscosity reduction of nonconventional crude oils. In this regard, investigation of ultra-dispersed catalysts based on transition metals is of current interest. The small particle sizes of catalysts yield a strong activity during aquathermolysis process and are able to penetrate deeply into porous media. In this paper, a synthesis and investigation of spherical iron oxide (magnetite) with particle size of 150 nm are proposed. Further, its efficiency within hydrogen donor during steam treatment of heavy oil is justified. The physical simulation of aquathermolysis process is carried with a heavy crude oil sample from Ashal'cha field of Tatarstan Republic at 250-300°C. The treatment time range in the presence of water with a ratio of 30 wt % was 6 and 24 hours. According to experimental results of X-ray diffraction and electron microscopy, it is revealed that increasing treatment time and temperature brings to formation of various derivative compounds of oxides such as maghemite, pyrite and hematite. Besides the results of SARA-analysis indicate the reduction in asphaltene fraction, which is explained by activity of catalysts directed to destruction of mostly asphaltene compounds. In its turn, the asphaltene reduction influenced the rheology of conversed oil, the viscosity of which reduced by 35 wt %. To continue investigation in this area is attractive in case of applying nanoparticles of iron oxide as a water suspension and compare the efficiency of such a system with already studied ultra-dispersed particles.

http://dx.doi.org/10.5593/sgem2018/1.4/S06.124

Keywords

Aquathermolysis, Catalyst precursor, Heavy oil, Magnetite

References

[1] Kurochkin A.K., Toptygin S.P., Sphere. Neftegaz, Russia, vol.11, issue 1, pp. 92-105, 2010.

[2] Vezirov R.R., Yavgildin I.R., Tuktarov I.O., Telyashev E.G., Khairudinov I.R., Imashev U.B., Chemistry and Technology of Fuels and Oils, Russia, vol. 6, pp. 23-25, 1995.

[3] Sharipov V.I., Beregovtsova N.G., Baryshnikov S.V., Kuznetsov B.N., Chemistry for Sustainable Development, Russia, vol. 3, pp. 287-291, 1997.

[4] Vezirov R.R., Larionov S.P., Obukhova S.A., Telyashev E.G., Imashev U.B., Oxidative catalytic conversion of heavy crude oil. Reactiv, Russia, 132 p., 1999.

[5] Nassar N.N., Hassan A., Pereira-Almao P. Colloids and surfaces A: Physicochem.Eng.Aspects, USA, vol. 384, pp. 145-149, 2011.

[6] Salih I. Sh. S., Mukhamatdinov I. I., Garifullina E. I., Vakhin A. V. Study of Fractional Composition of Asphaltenes in Hydrocarbon Material, Chemistry and Technology of Fuels and Oils, vol. 54, issue 1, pp 44-50, 2018.

[7] Vakhin A.V., Sitnov S.A., Mukhamatdinov I.I., Onishchenko Y.V., Feoktistov D.A. Aquathermolysis of High-Viscosity Oil in the Presence of an Oil-Soluble Iron-Based Catalyst, Chemistry and Technology of Fuels and Oils, Russia, vol. 53, issue 5, pp. 666-674, 2017.

[8] Gafurov M.R., Volodin M.A., Rodionov A.A., Sorokina A.T., Dolomatov M.Yu., Petrov A.V., Vakhin A.V., Mamin G.V., Orlinskii S.B. EPR study of spectra transformations of the intrinsic vanadyl-porphyrin complexes in heavy crude oils with temperature to probe the asphaltenes' aggregation, Journal of Petroleum Science and Engineering, vol. 166, pp 363-368, 2018.

[9] Tverdokhlebov V.P., Khramenko S.A., Buriukin F.A., Pavlov I.V., Proshkin S.E., SFU Magazine. Series: Chemistry, Russia, vol. 3, issue 4, pp. 369-386, 2010.

[10] Yusupova T.N., Ganeeva Y.M., Romanov G.V., Barskaya E.E., Morozov V.I, Okhotnikova E.S, Vakhin A.V., Change in the structural-group composition of bitumen asphaltenes upon thermal bitumen recovery, Petrol. Chem., Russia, vol. 57, issue 3, pp. 198-202, 2017.

[11] Ivanova A. G., Vakhin A. V., Voronina E. V., Pyataev A. V., Nurgaliev D. K., Sitnov S. A., Mössbauer study of products of the thermocatalytic treatment of kerogen-containing rocks, Bulletin of the Russian Academy of Sciences. Physics, vol. 81, issue 7, pp 817-821, 2017.

[12] Vasiliev A.L., Balushkina N.S., Kalmykov G.A., Saved M.Yu., Presnyakov M.Yu., Pichkur E.B., Mikhutkin A.A., Ivanova A.G., Uvarov O.V., Bogdanovich N.N., Pleshakov A.M., Investigation of the microstructure of the oil bearing rocks of the Bazhenov suite by the methods of electron and ion microscopy, SPE Joint Workshop on Shale Oil, Russia, 2015.